With Compliments
K. W. Lee
Apr. 1999

A REVISION OF THE ILLUSTRATED TAXONOMIC KEYS TO GENERA AND SPECIES OF MOSQUITO LARVAE OF KOREA (Diptera, Culicidae)

By
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PREFACE

"Illustrated Taxonomic Keys to Genera and Species of Mosquito Larvae of Korea," which was written preliminarily in 1991 by entomologists of the 5th Medical Detachment, 8th U.S. Army, has been utilized for years as the most comprehensive and convenient taxonomic manual for identification of the mosquitoes of Korea. Since 1991, some new distribution records have been recorded in Korea and much new taxonomic information has been published in a wide variety of scientific publications. This work attempts to combine information from all of these sources into a single document, as well as to summarize revised taxonomic synonyms of species occurring in Korea. Based on the available publications, the total number of mosquitoes recorded from Korea is now considered to be 55 species in 10 genera.

At present, the 5th Medical Detachment is continuing its mosquito surveillance program on the taxonomy, biology and distribution of the mosquito fauna. The preparation of these revised pictorial keys is part of this continuing taxonomic study. An attempt has been made to produce a key as simple and accurate as possible. The illustrations, to include key characteristics, were selected from a composite of several specimens representing all species listed. The author made every effort to provide the most detailed illustrations for identification.

As collections of specimens continue, there is a possibility that additional species will be found in Korea. I hope this publication will provide useful information not only for military and civilian entomologists of the 8th U.S. Army, but also for the other entomologists who are interested in mosquito taxonomy in Korea.

The author wishes to express his sincere thanks to Major William B. Miller and Captain Robert S. Richards, Commander, 5th Medical Detachment (Entomology) for their support and editorial review of the manuscript, and also to Lieutenant Colonel Jeffrey B. Clark, Commander, Headquarters, 168th Medical Battalion, 18th Medical Command, U. S. Army, for his support and encouragement.

Finally the author desires to express his appreciation to Dr. Heung Chul Kim, Medical Entomologist, the 5th Medical Detachment, who assisted the senior author in checking the illustrations and the proofreading the manuscript.

LEE, Kwan Woo
April 1999

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4. **TERMINAL SEGMENT (VII-X) OF ABDOMEN**

ABBREVIATION:

A = Antenna
C = Head
FC = Frontoclypeus
CE = Compound eye
CS = Comb scales
PC = Pecten
G = Anal gills
M = Mesothorax
MP = Mentum plate
P = Prothorax
PH = Palmate hair
PT = Pecten tooth
S = Siphon
AC = Acus
SL = Saddle
SM = Stemma
T = Metathorax
TP = Tergal plate
1-MX = Cardinal seta

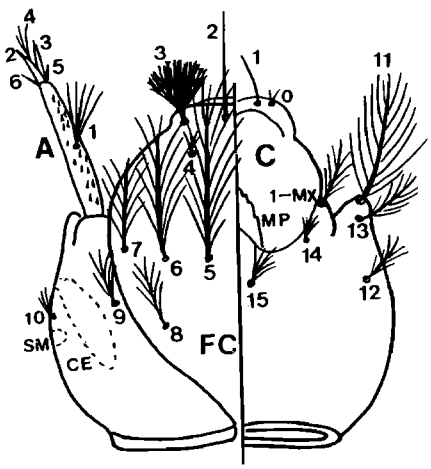


Fig. 1

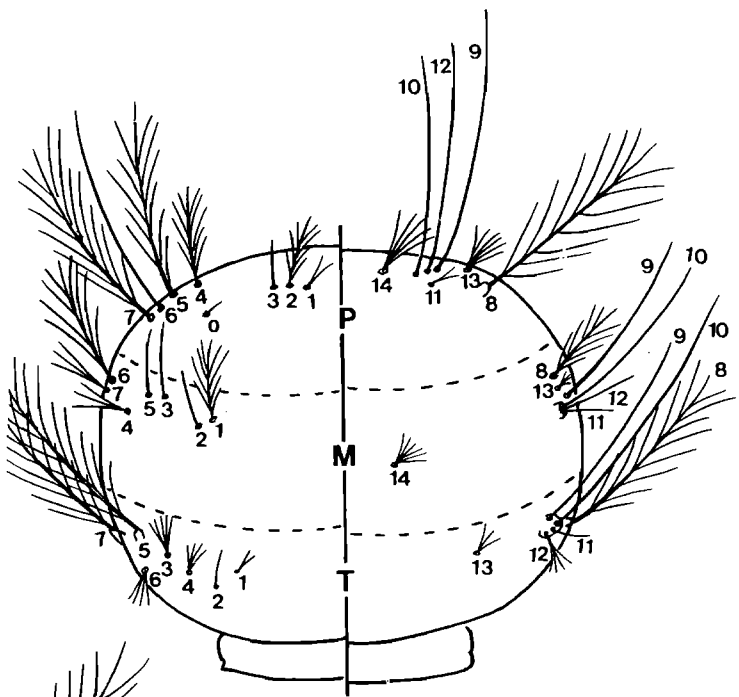
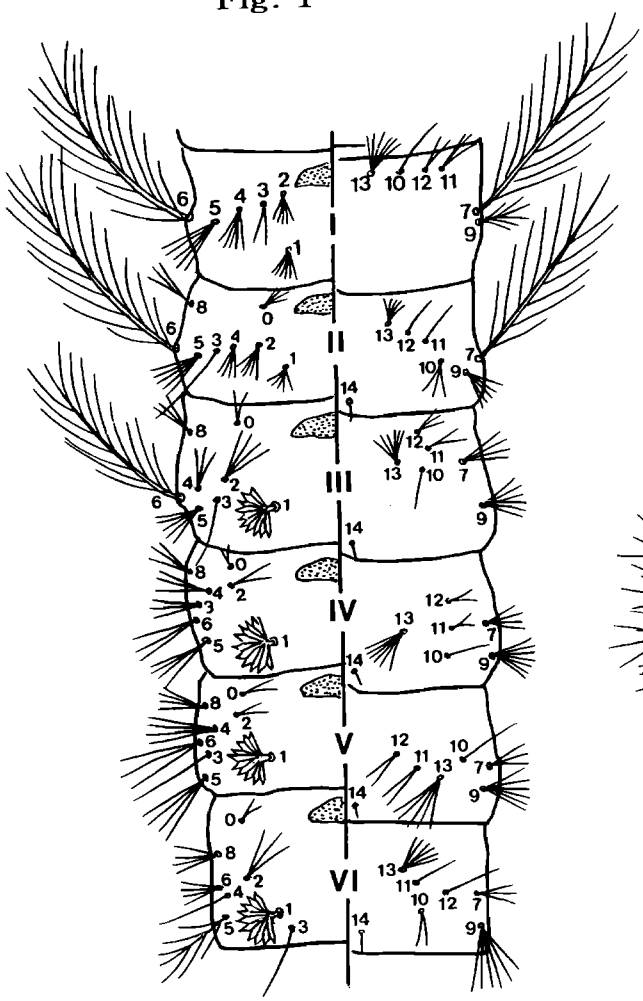


Fig. 2



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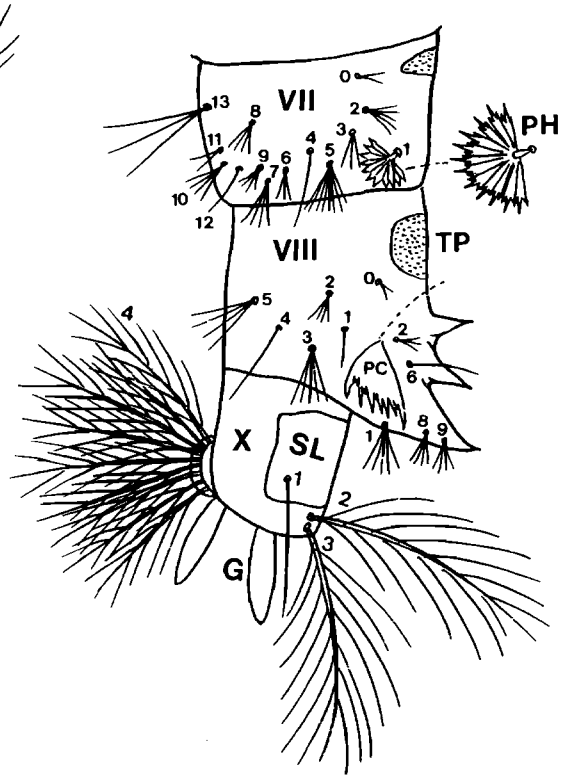

Fig. 4

FIGURES 5-8. FOURTH INSTAR LARVA OF CULICINE MOSQUITOES

5. **HEAD**: dorsal-left, ventral-right
6. **THORAX**: dorsal-left, ventral-right
7. **ABDOMINAL SEGMENT (I-VI)**: dorsal-left, ventral-right
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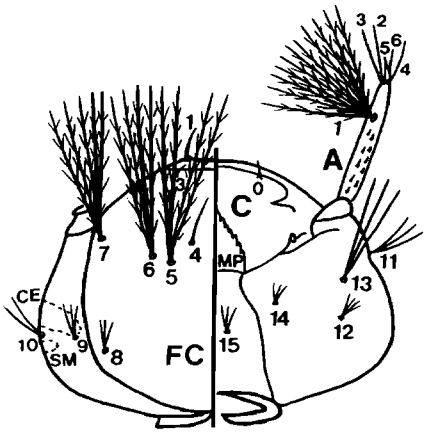


Fig. 5

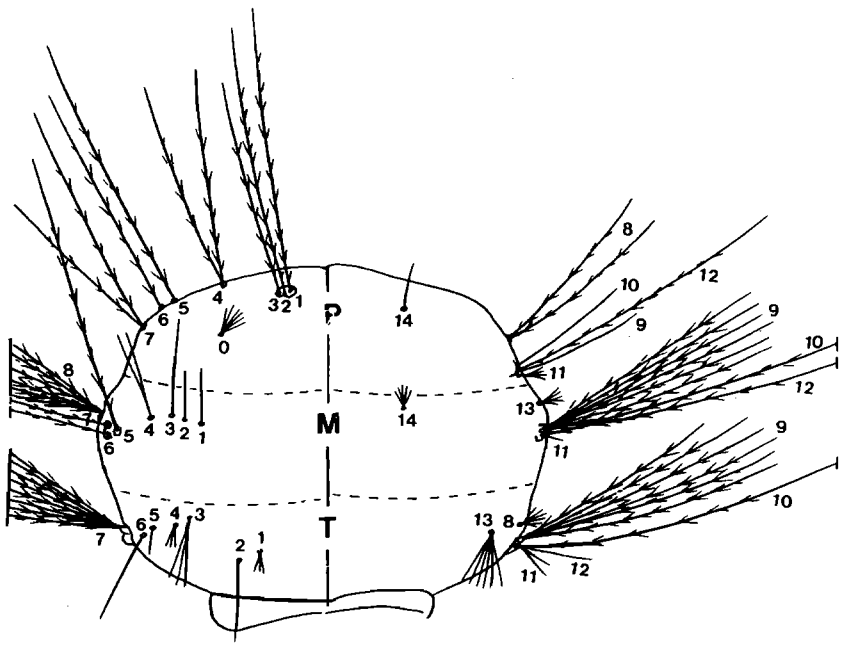
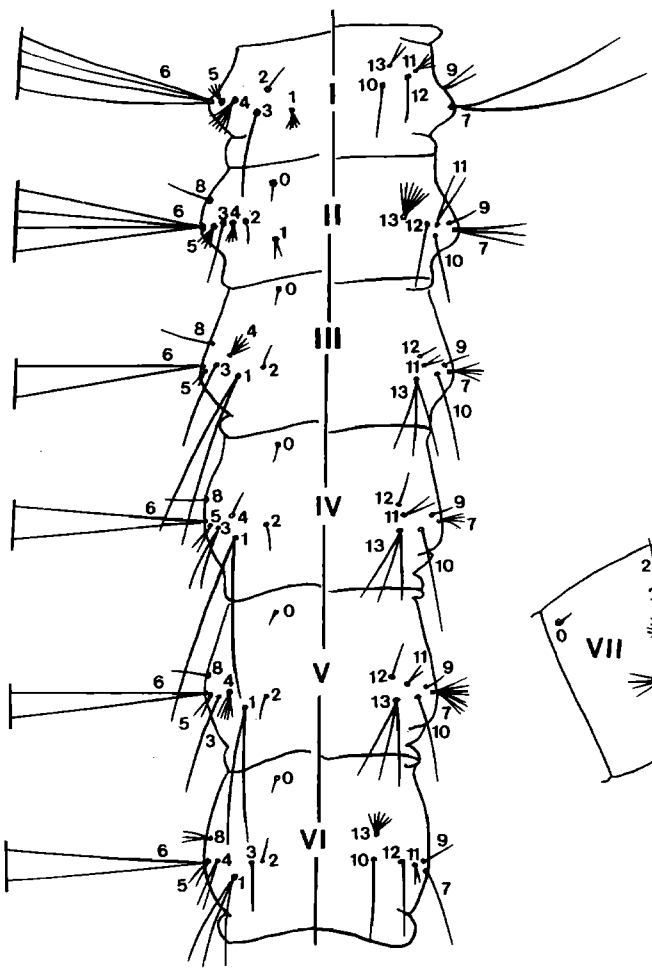


Fig. 6



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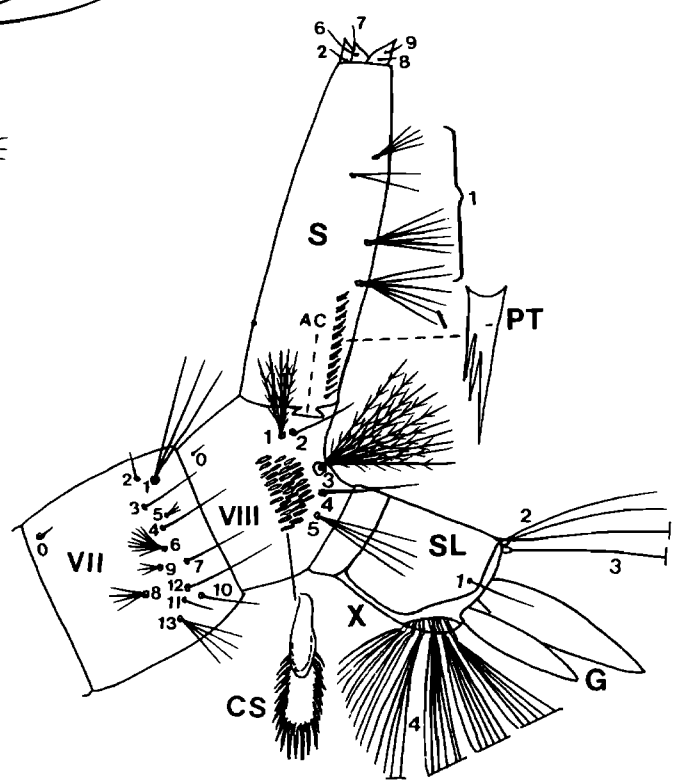
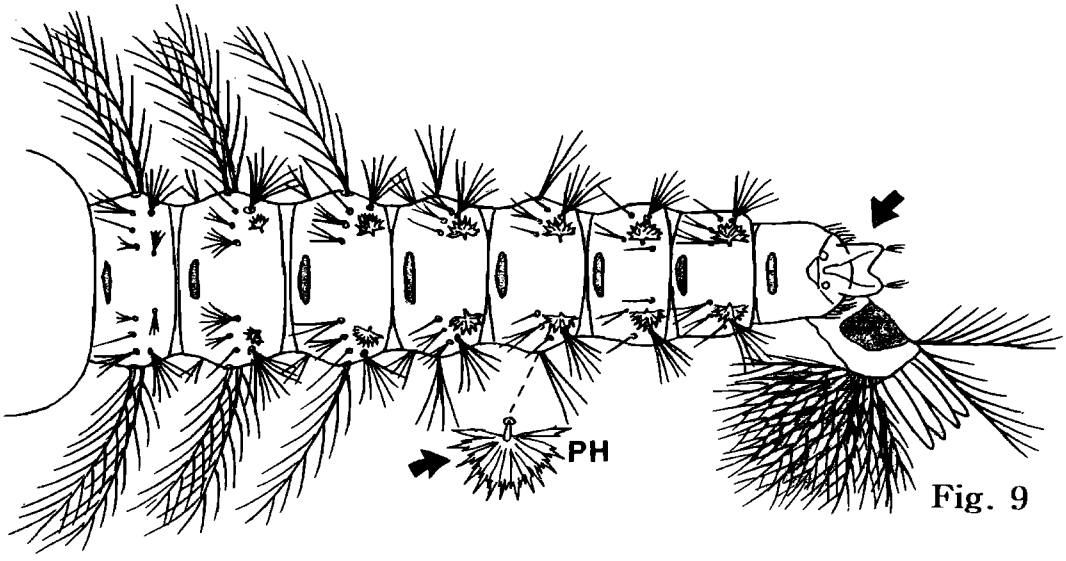


Fig. 8

KEY TO THE GENERA OF CULICIDAE

1. Palmate hairs present on some abdominal segments; air tube absent (Fig. 9)..... ***Anopheles***

   Palmate hairs absent on abdominal segments; air tube present (Fig. 10) 2



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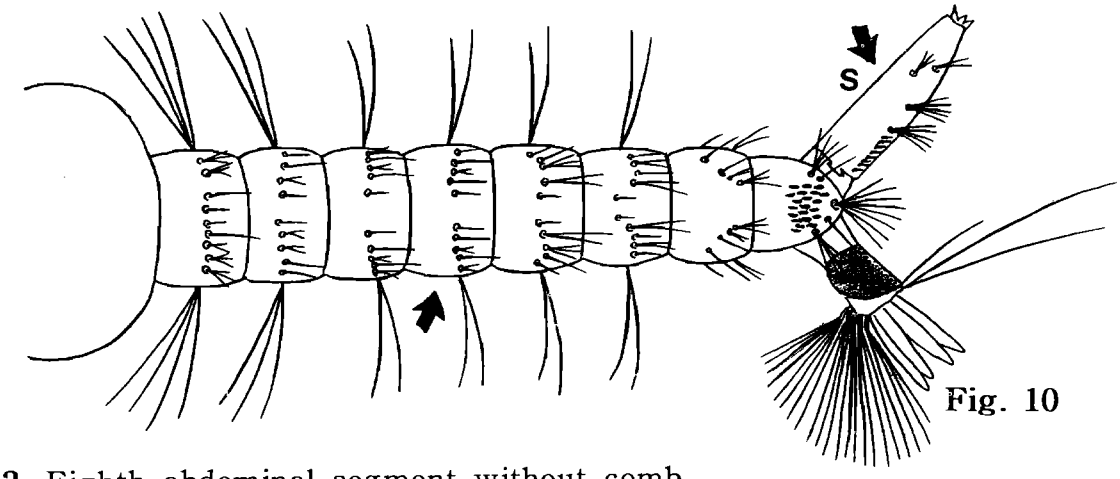


Fig. 10

2. Eighth abdominal segment without comb, but with lateral chitinized plate on each side carrying two strong bristles and some small hairs (Fig. 11) ..... ***Toxorhynchites (Tx. christophi)***

Eighth abdominal segment with comb, and
without lateral chitinized plates (Fig. 12)..... 3

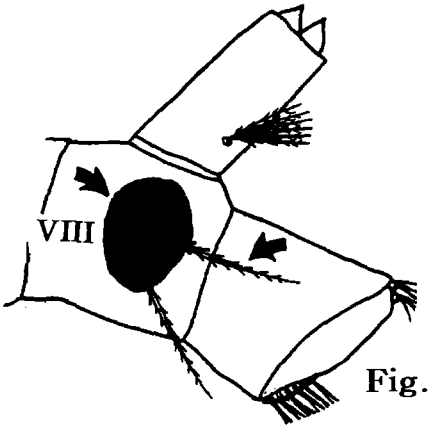


Fig. 11

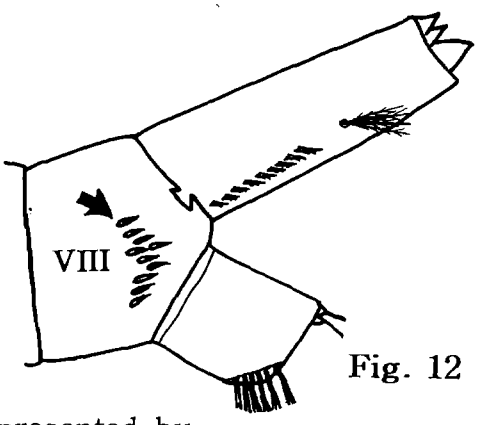
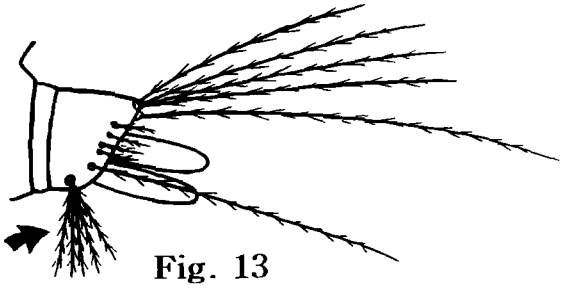


Fig. 12

3. Ventral brush of anal segment represented by
a single pair of hairs (Fig. 13); thoracic
hair 7-T modified into a long spine (Fig. 14) ..... ***Tripteroides***
(Tp. bambusa bambusa)

Ventral brush of anal segment of more than 8
separate hairs (Fig. 15); thoracic hair 7-T
not modified into a long spine (Fig. 16) 4



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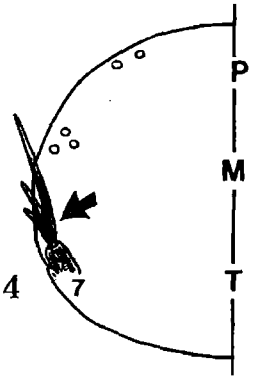

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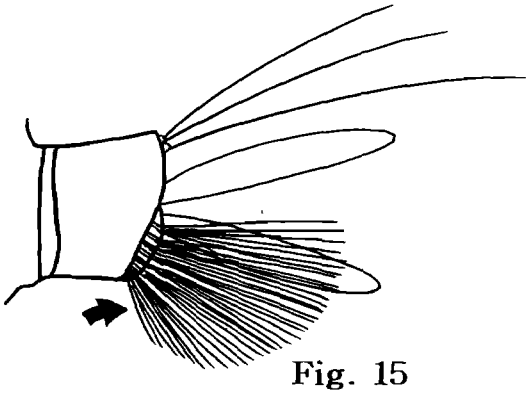

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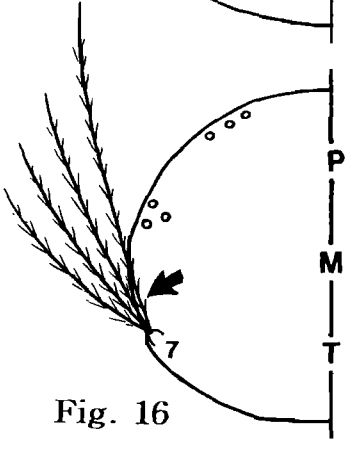
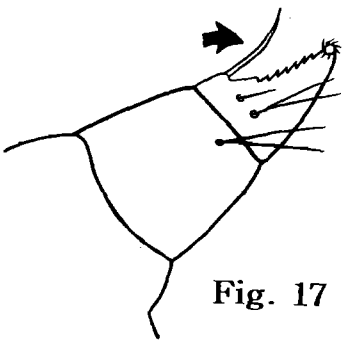


Fig. 16

4. Siphon valves with chitinous hooks (Fig. 17) 5

   Siphon valves without hooks (Fig. 18) 6



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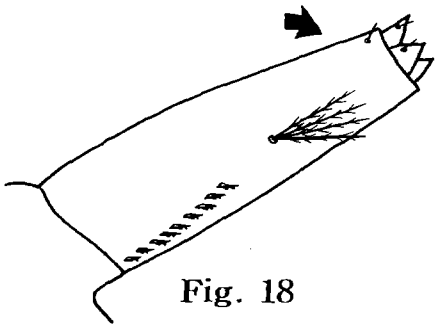


Fig. 18

5. Flaggellar segment of antenna very long and flexible (Fig. 19); comb scales 5–10, with apex pectinated (Fig. 20) ..... ***Coquillettidia (Coq.) ochracea***

   Flaggellar segment of antenna short and rigid (Fig. 21); comb scales 1–3, with apex rounded (Fig. 22) ..... ***Mansonia (Mnd.) uniformis***

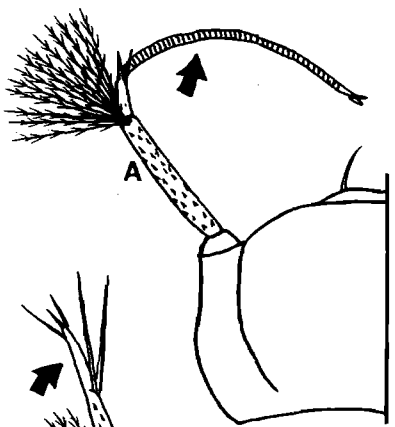


Fig. 19

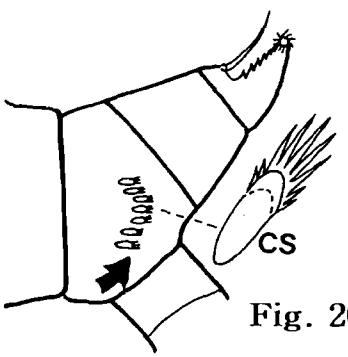


Fig. 20

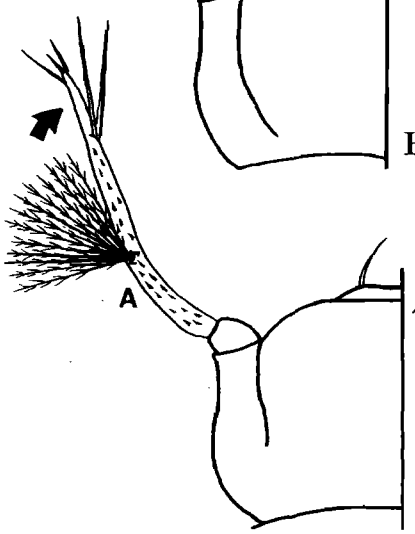


Fig. 21

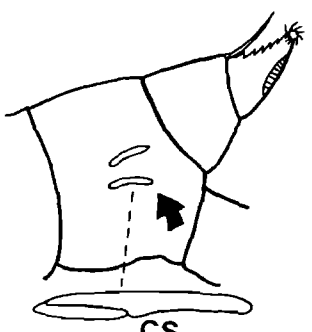


Fig. 22

6. Siphon without pecten (Fig.23) ..... *Armigeres (Ar. subalbatus)*

Siphon with pecten (Fig. 24) 7

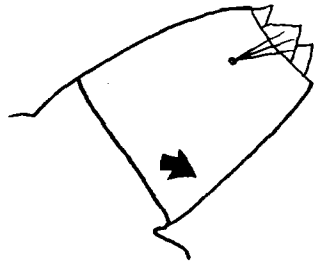


Fig. 23

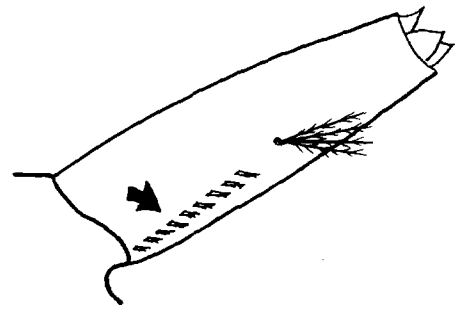


Fig. 24

7. Siphon with more than three pairs of subventral hair tufts (Fig. 25) ..... *Culex*

Siphon with only one pair of subventral hair tufts Fig. 26) 8

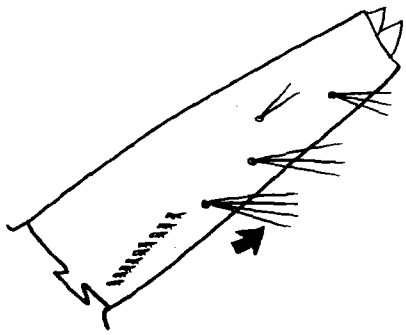


Fig. 25

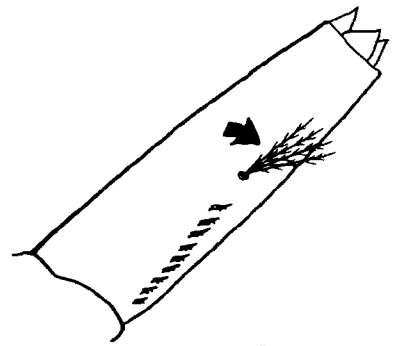


Fig. 26

8. Hair tufts on siphon arising very near base of siphon (Fig. 27) ..... *Culiseta* (see 9)

Hair tufts on siphon arising in meddle part of siphon (Fig. 28) ..... ***Aedes & Heizmannia***

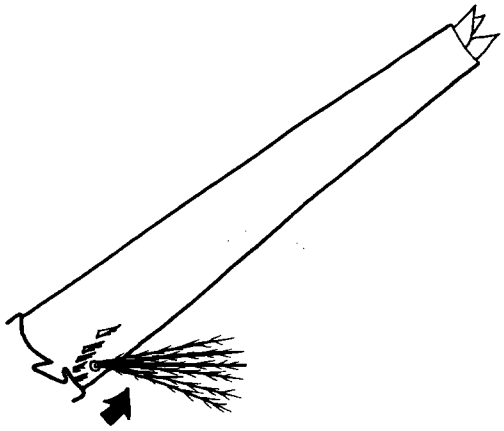


Fig. 27

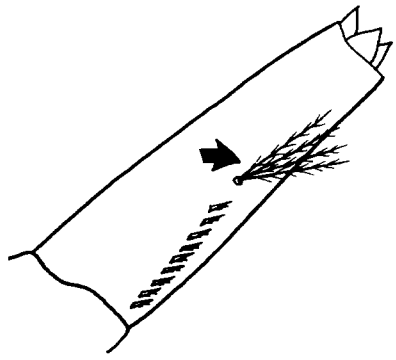
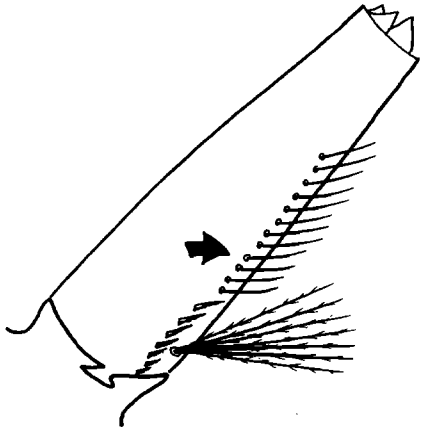


Fig. 28

9. Pecten followed by a row of numerous simple hairs (Fig. 29) ..... ***Cs. (Cus.) bergrothi***

Pecten not followed by such hairs (Fig. 30) ..... ***Cs. (Cuc.) nipponica***



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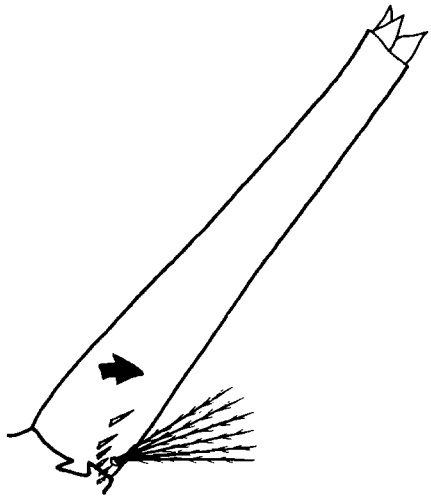

Fig. 30

KEY TO THE SPECIES OF *ANOPHELES*

1. Head hair 3-C single (Fig. 31); thoracic hair 1-P plumose (Fig. 32) ..... ***An. lindesayi japonicus***

   Head hair 3-C multiple branches (Fig. 33); thoracic hair 1-P single or 2-4 branches (Fig. 34) 2

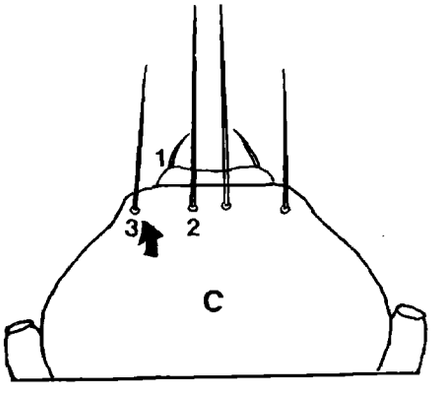

Fig. 31

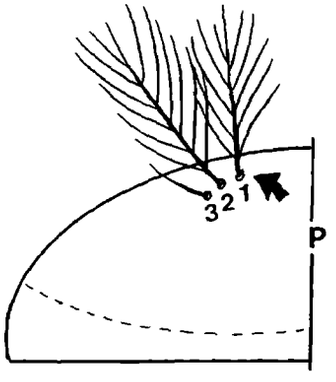

Fig. 32

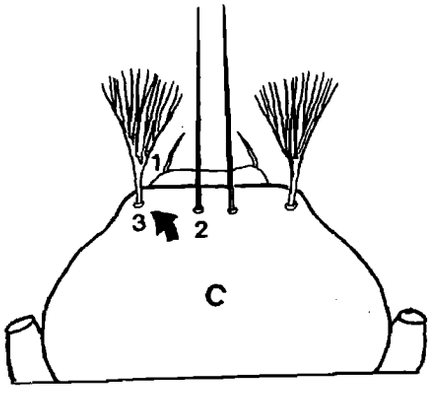

Fig. 33

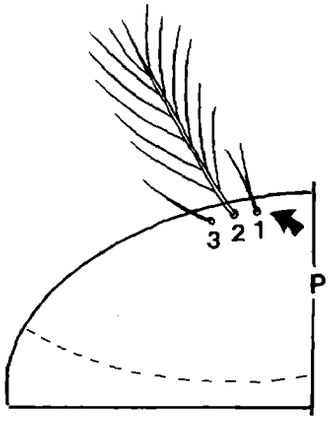

Fig. 34

2. Head hair 3-C with 3-8 branches (Fig. 35) ..... *An. koreicus*

Head hair 3-C with over 10 branches (Fig. 36) 3

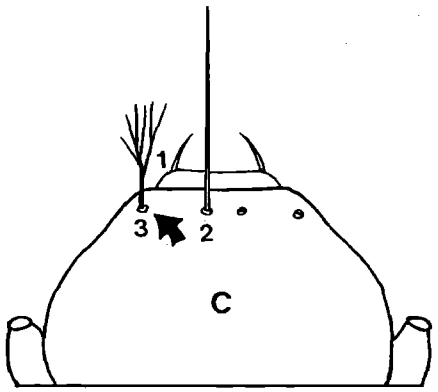

Fig. 35

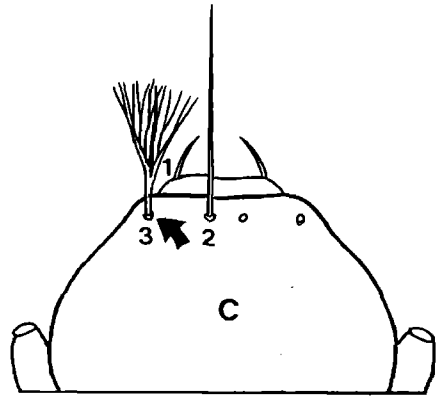

Fig. 36

3. Head hair 3-C with 10-30 branches; antennal hair 1-A about as long as 1/4 - 1/3 of the antennal shaft, positioned near base of antenna(Fig. 37) ..... *An. sineroides*

Head hair 3-C with 30-60 branches; antennal hair 1-A about as long as 1/2 of the antennal shaft, positioned at middle of antenna (Fig. 38) ..... *An. sinensis*
An. yatsushiroensis
An. pullus
An. lesteri

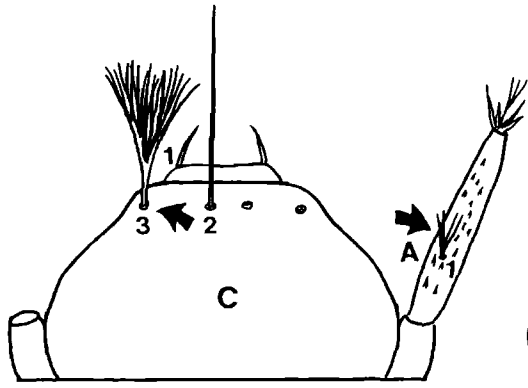

Fig. 37

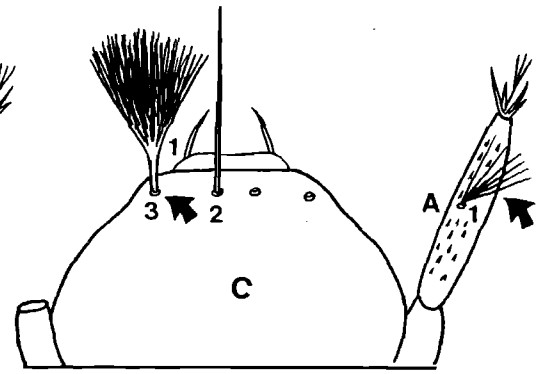

Fig. 38

KEY TO THE SPECIES OF *CULEX*

1. Siphon as long as saddle; pecten and ventral hairs extending to nearly apex of siphon (Fig. 39) ..... ***Cx. halifaxii* & *Cx. fuscanus***

   Siphon at least twice as long as saddle; pecten confined to basal half of siphon (Fig. 40) 2

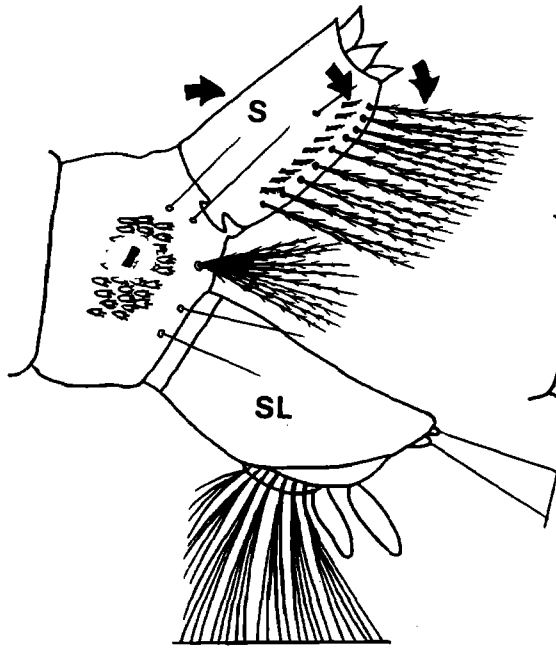

Fig. 39

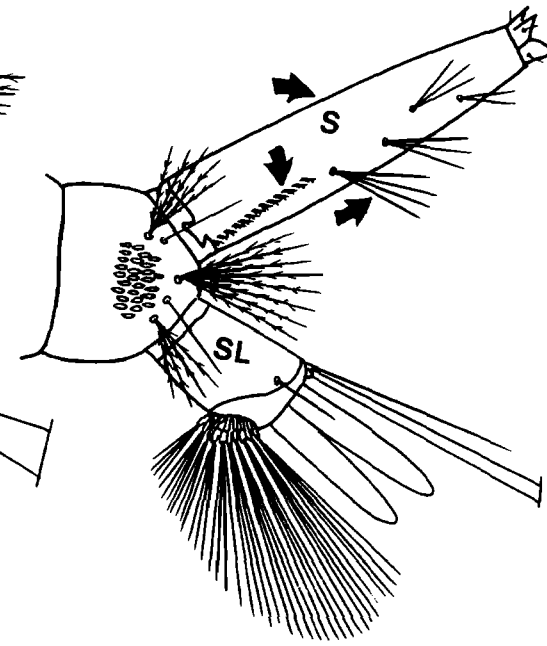

Fig. 40

2. Thoracic hair 3-P definitely shorter than 1, 2-P and single or branched (Fig. 41) 3

   Thoracic hair 3-P as long as 1, 2-P and single or bibranched (Fig. 42) 6

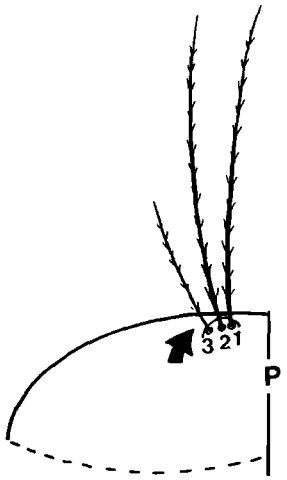

Fig. 41

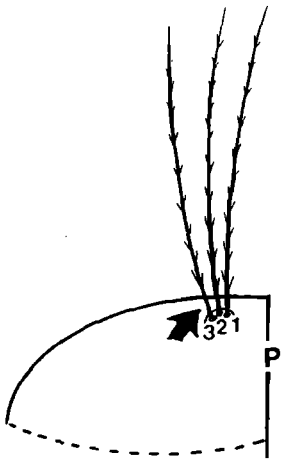

Fig. 42

3. Thoracic hair 4-P slender, branched and shorter shorter than 3-P (Fig. 43) ..... ***Cx. hayashii hayashii***

   Thoracic hair 4-P stout, bibranched and longer than 3-P (Flig. 44) **4**

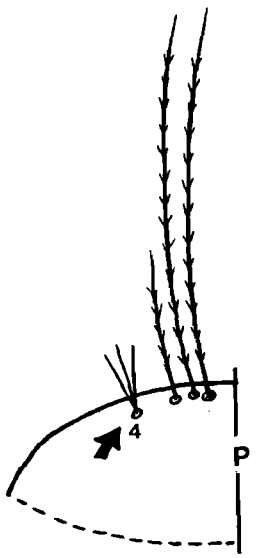

Fig. 43

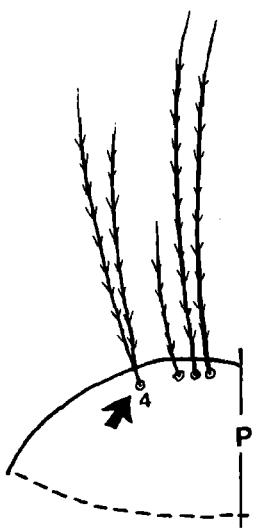

Fig. 44

4. Thoracic hair 3-P slender, branched and very short (Fig. 45) ..... *Cx. rubensis*

   Thoracic hair 3-P moderately stout, single or bibranched and distinctly shorter than 1, 2-P (Fig. 46) 5

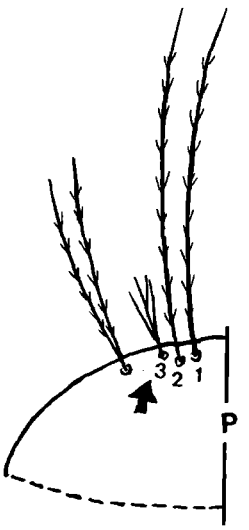

Fig. 45

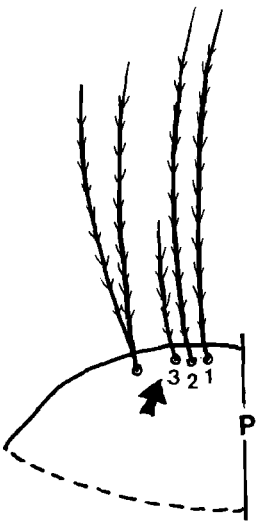

Fig. 46

5. Thoracic hairs 1, 3-P usually bibranched, (Fig. 47) .. *Cx. sasai*

   Thoracic hairs 1, 3-P usually single, (Fig. 48) .. *Cx. infantulus*

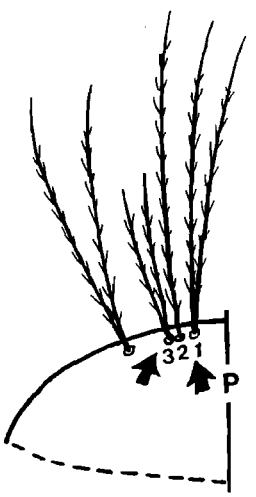

Fig. 47

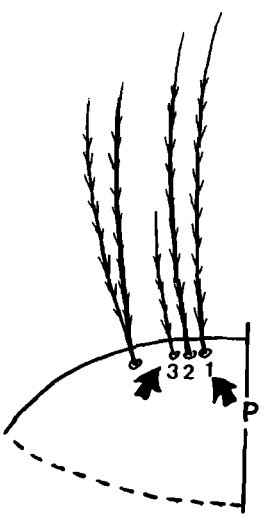

Fig. 48

6. Thoracic hairs 1, 3-P bibranched (Fig. 49) ..... ***Cx. kyotoensis***

Thoracic hairs 1,3-P single (Fig. 50)..... 7

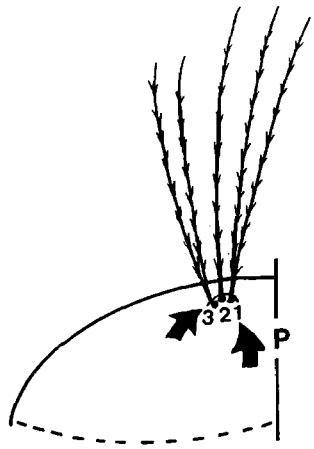

Fig. 49

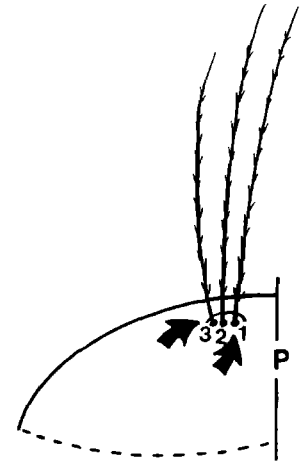

Fig. 50

7. Head hair 1-C slender and brown (Fig. 51) 8

Head hair 1-C stout and darker (Fig. 52) 11

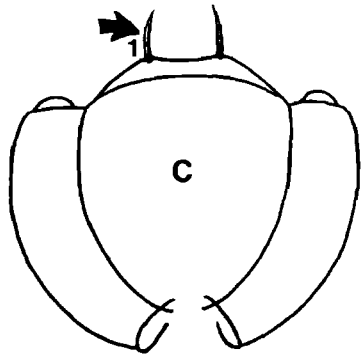

Fig. 51

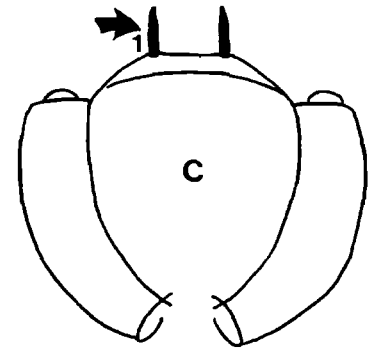

Fig. 52

8. Siphon hair tufts strong, arranged in a zigzag, almost ventral row and evenly spaced, siphon without lateral hair tuft (Fig. 53) ..... ***Cx. inatomii***

Siphon hair tufts weak, arranged usually in a regular subventral row, siphon with lateral hair tuft (Fig. 54) **9**

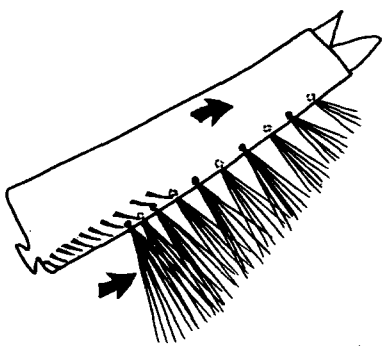

Fig. 53

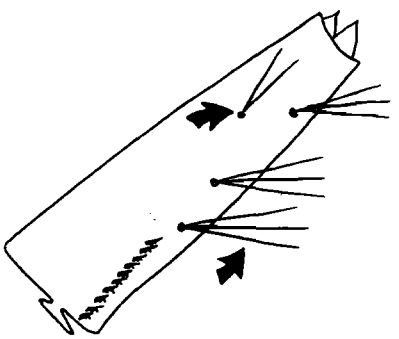

Fig. 54

9. Siphon with 4 pairs of subventral hairs; siphon long, usually 4 to 5 times longer than its basal width (Fig. 55) ..... ***Cx. vagans***

Siphon with 3 pairs of subventral hairs; siphon short, approximately 3 times longer than its basal width (Fig. 56) **10**

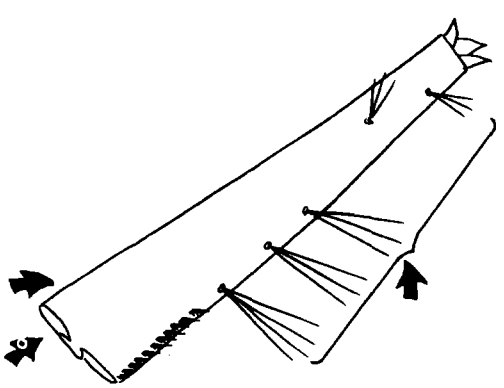

Fig. 55

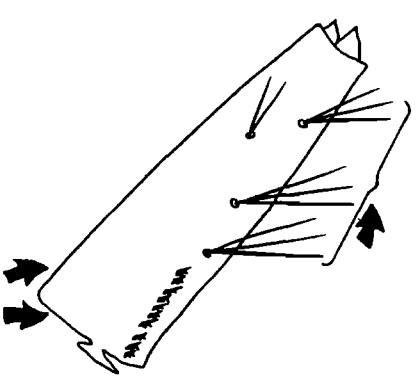

Fig. 56

10. Siphon widest at base (Fig. 57) ..... ***Cx. pipiens pallens***
Cx. pipiens molestus

Siphon widest at basal third (Fig. 58) .....
..... ***Cx. pipiens quinquefasciatus***

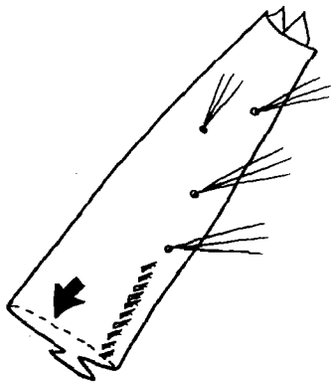

Fig. 57

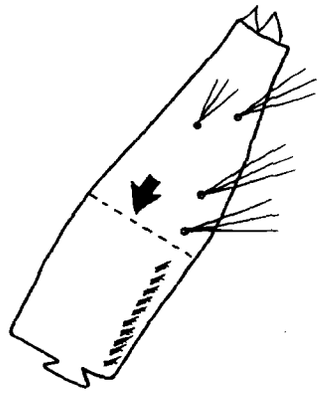

Fig. 58

11. Comb with 3-14 large scales (Fig. 59) 12

Comb with 24-48 smaller scales (Fig. 60) 15

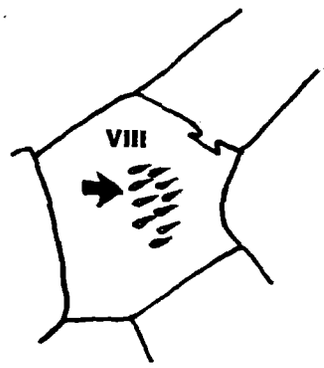

Fig. 59

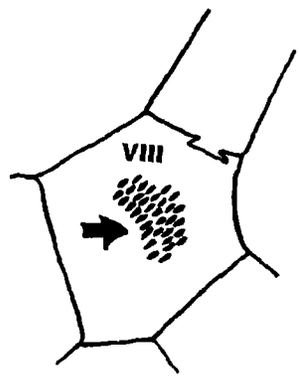

Fig. 60

12. Pecten with 1-8 teeth; siphon without lateral hair tuft (Fig. 61) 13

    Pecten with 6-14 teeth; siphon with lateral hair tuft (Fig. 62) 14

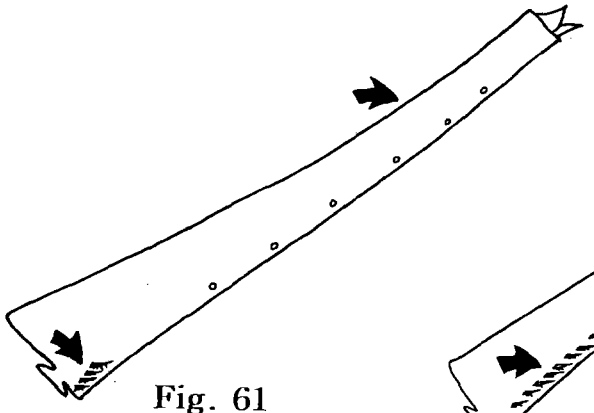

Fig. 61

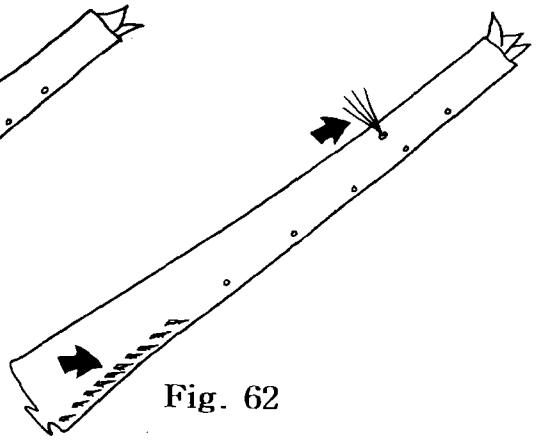

Fig. 62

13. Mentum plate with extremely small and numerous teeth (Fig. 63); thoracic hair 4-P long, barbed (Fig. 64); siphon with 4 pairs of subventral hair tufts (Fig. 65) ..... ***Cx. bitaeniorhynchus***

    Mentum plate with coarse apical teeth, diminishing gradually toward base (Fig. 66); thoracic hair 4-P short, smooth (Fig. 67); siphon with 6 pairs of subventral hair tufts (Fig. 68) ..... ***Cx. sinensis***

Fig. 63

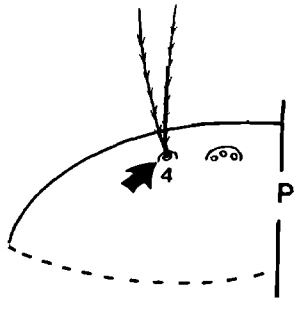

Fig. 64

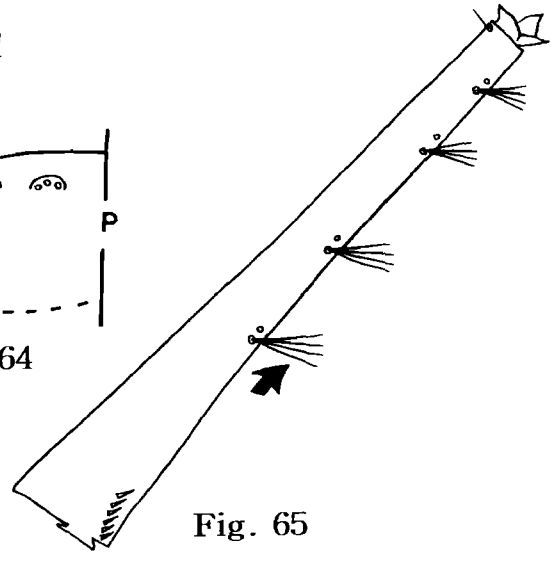

Fig. 65

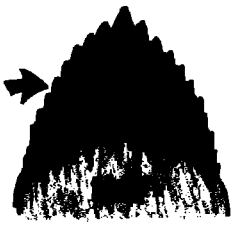

Fig. 66

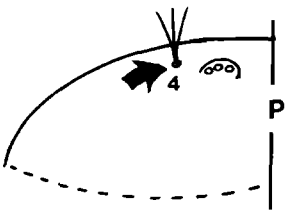

Fig. 67

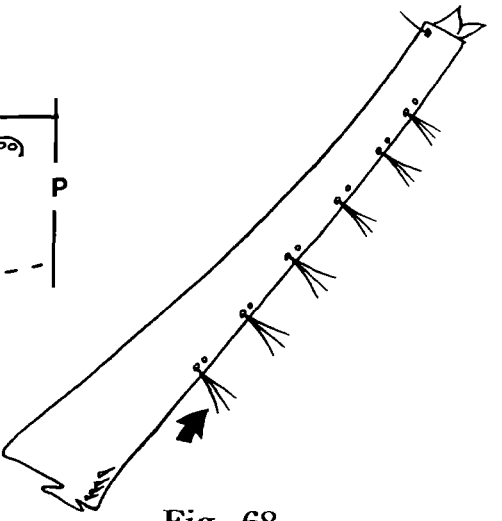

Fig. 68

14. Subventral hairs of siphon about half as long as siphon (Fig. 69) ..... ***Cx. whitmorei***

Subventral hairs of siphon less than half as long as siphon (Fig. 70) ..... ***Cx. pseudovishnui***

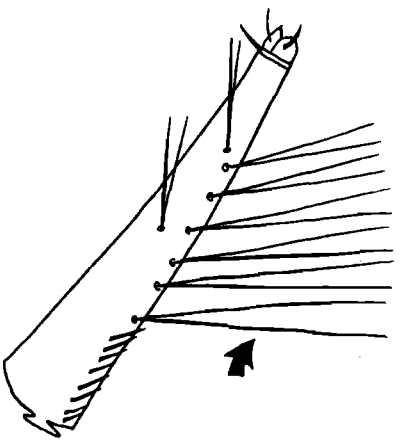

Fig. 69

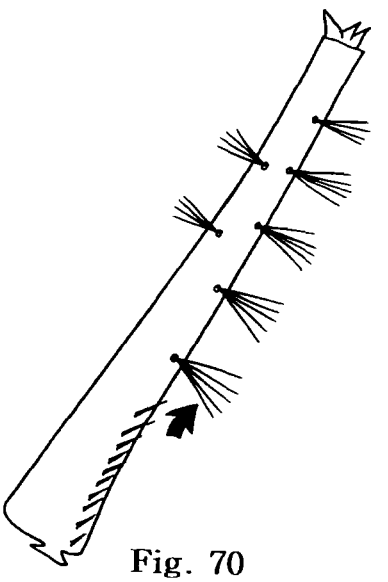

Fig. 70

15. Head hair 1-C very thick, rather blunt (Fig. 71); anal gills very short and rounded, slightly longer than wide (Fig. 72) ..... *Cx. sitiens*

Head hair 1-C not thick, sharply pointed (Fig. 73); anal gills at least 3 times as wide, usually longer than anal segment (Fig. 74) **16**

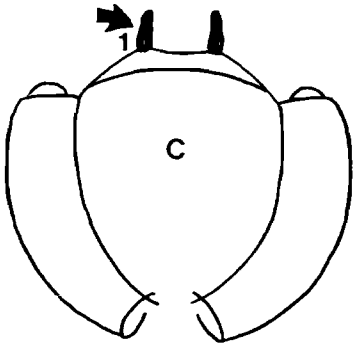

Fig. 71

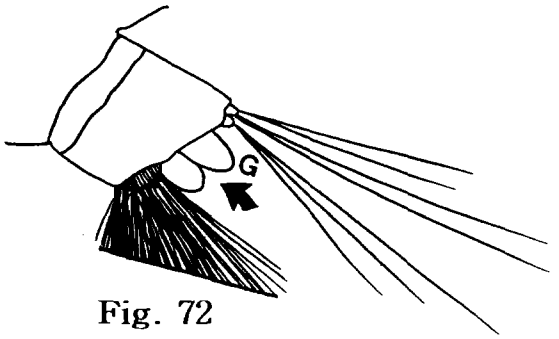

Fig. 72

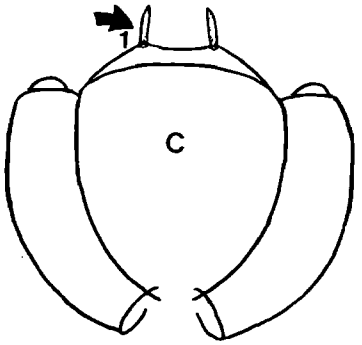

Fig. 73

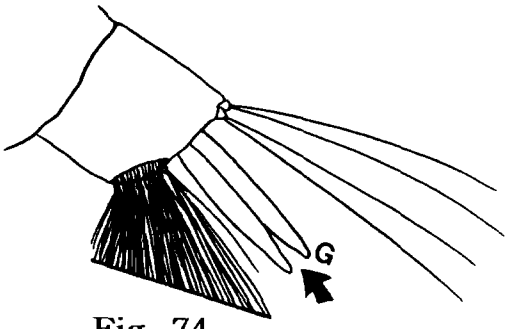

Fig. 74

16. Thoracic hair 4-P bibranched (Fig. 75); comb scales fringed apically and laterally (Fig. 76) ..... *Cx. tritaeniorhynchus*

Thoracic hair 4-P single (Fig. 77); comb scales pectinate on each side with spiniform tip (Fig. 78) **17**

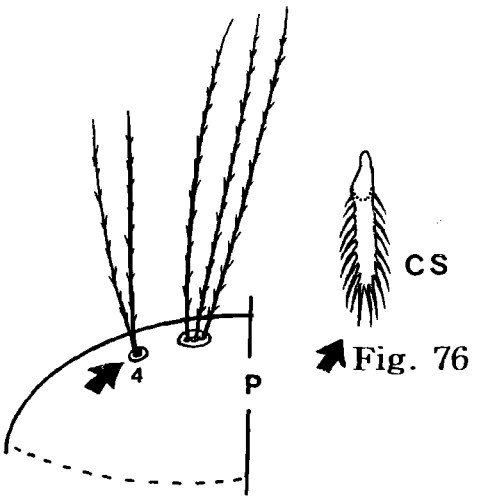

Fig. 76

Fig. 75

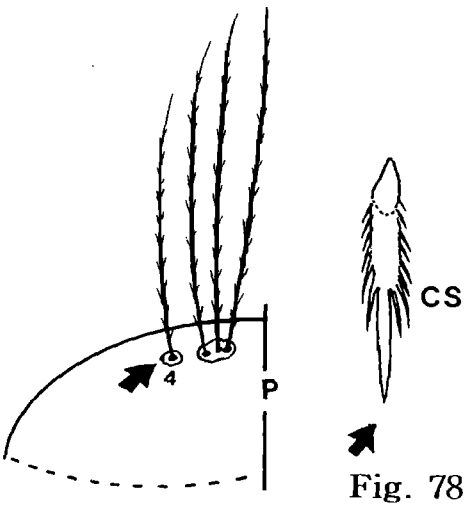

Fig. 78

Fig. 77

17. Siphon with 6-8 subventral hair tufts in a zigzag row; 2 pairs of strong subventral spines on apical half of siphon tube (Fig. 79) ..... ***Cx. jacksoni***

    Siphon with 10-14 subventral hair tufts, in a zigzag row basally, more paired apically; strong spines absent on siphon tube (Fig. 80) 18

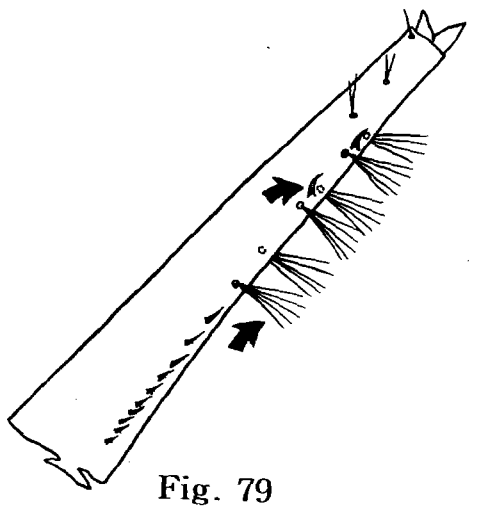

Fig. 79

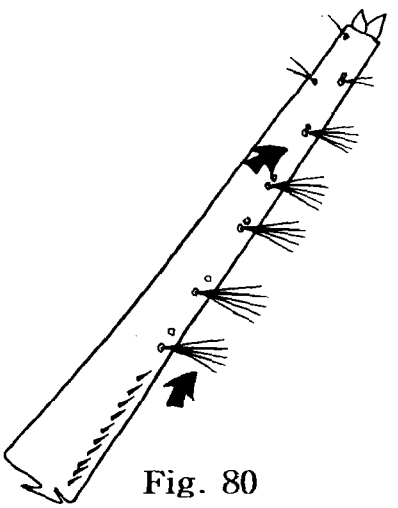

Fig. 80

18. Head hair 4-C 3-5 branched (Fig. 81); thoracic hair 13-T 1-3 branched (Fig. 82) ..... ***Cx. mimeticus***

Head hair 4-C 1-2 branched (Fig. 83); thoracic hair 13-T usually more than 10 branched (Fig. 84) ..... ***Cx. orientalis***

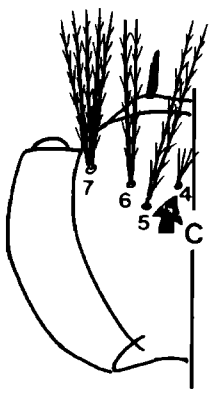

Fig. 81

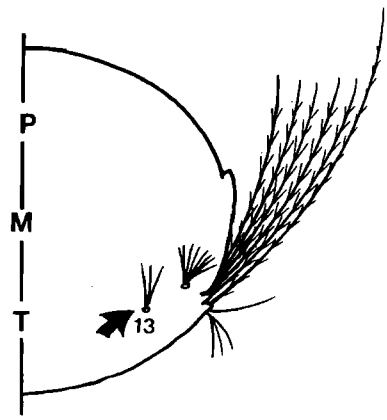

Fig. 82

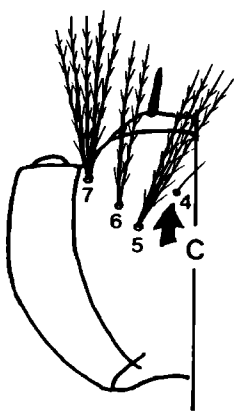

Fig. 83

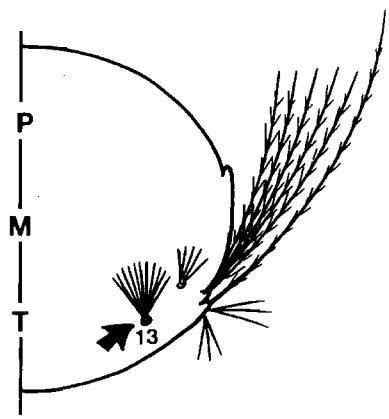

Fig. 84

KEY TO THE SPECIES OF *AEDES* AND *HEIZMANNIA*

1. 3-20 large comb scales in a single row, or in an irregular row, or more or less in 2 rows (Fig. 85) 2

   20-70 comb scales usually smaller, arranged in several rows, or more or less in a triangular patch (Fig. 86) 12

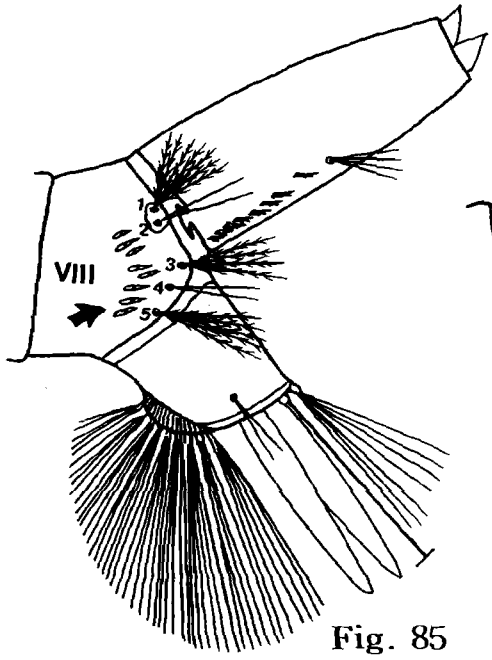

Fig. 85

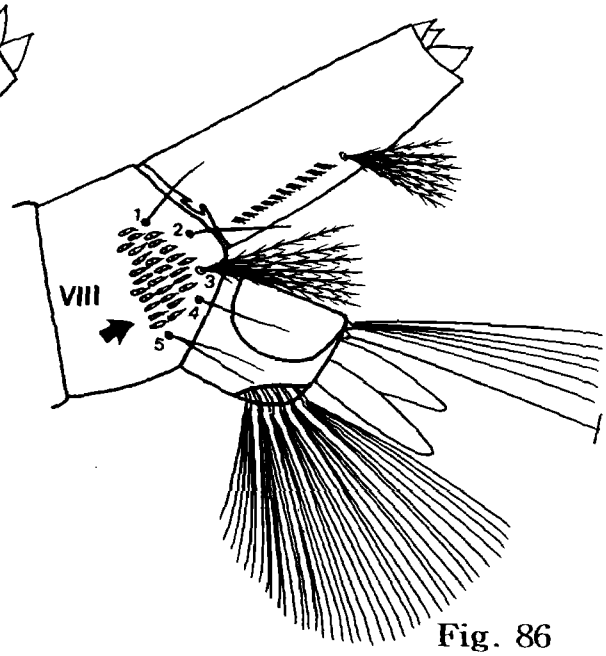

Fig. 86

2. Antennal shaft smooth (Fig. 87) 3

   Antennal shaft with small spicules or spines (Fig. 88)..... 6

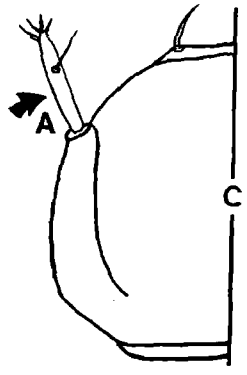

Fig. 87

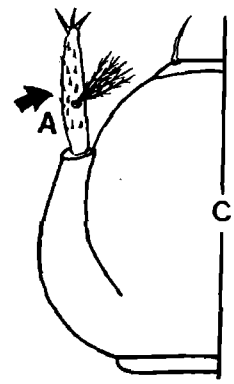

Fig. 88

3. Comb scales with 2-4 strong basal lateral spines on each side (Fig. 89) ..... ***Ae. chemulpoensis***

   Comb scales without basal lateral spines, but finely fringed (Fig. 90) 4

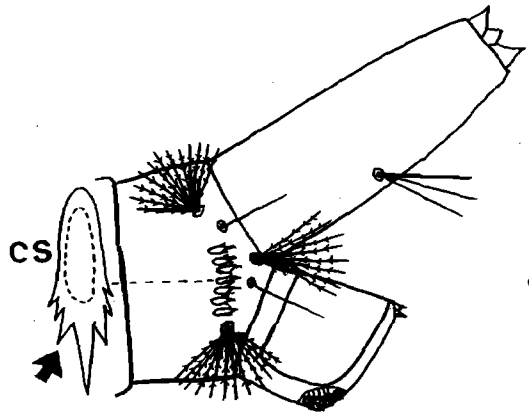

Fig. 89

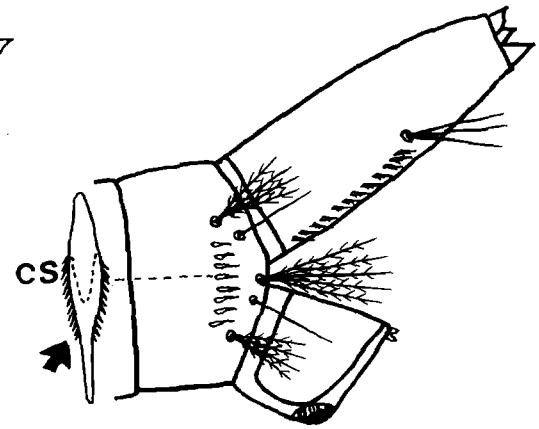

Fig. 90

4. Abdominal hairs 1, 5-VIII with less than 4 branches (Fig. 91) ..... ***Ae. albopictus***

   Abdominal hairs 1, 5-VIII with more than 6 branches (Fig. 92) 5

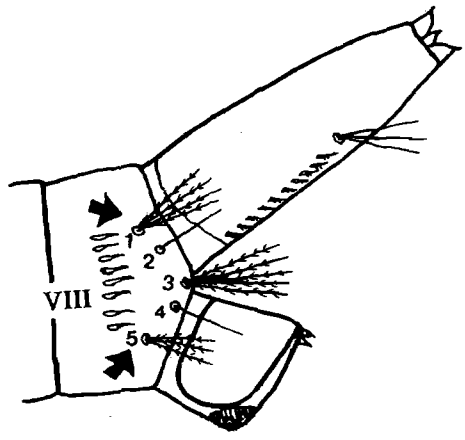

Fig. 91

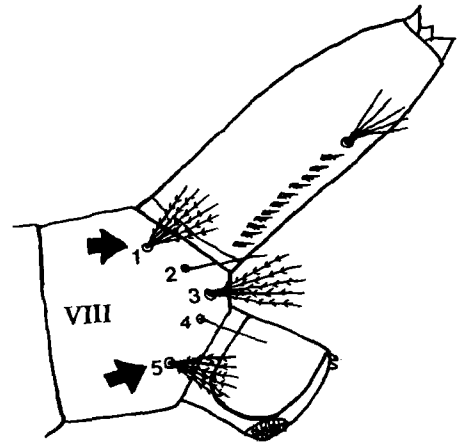

Fig. 92

5. Thoracic hair 14-P with more than 4 branches (Fig. 93); saddle incomplete (Fig. 94) ..... ***Ae. flavopictus flavopictus***

Thoracic hair 14-P with 2 branches (Fig. 95); saddle usually complete (Fig. 96) ..... ***Ae. galloisi***

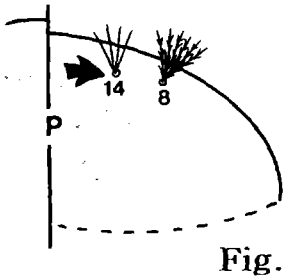

Fig. 93

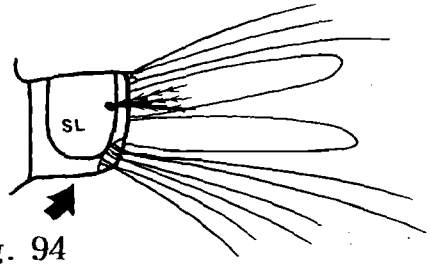

Fig. 94

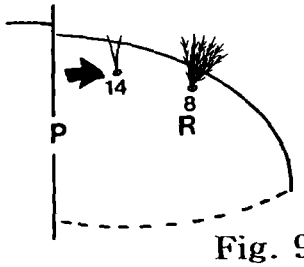

Fig. 95

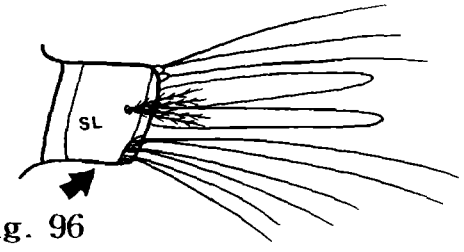

Fig. 96

6. All pecten teeth evenly spaced and all about same size (Fig. 97); head hair 4-C as large as 5-C (Fig. 98) ..... ***Ae. nipponicus***

The 1-3 pecten teeth furthest from base of siphon more widely spaced than basal teeth (Fig. 99); head hair 4-C much smaller than 5-C (Fig. 100) 7

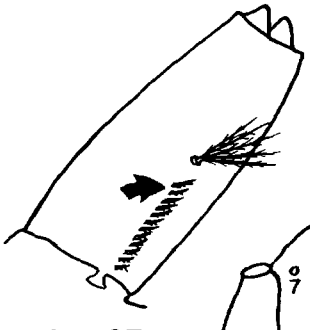

Fig. 97

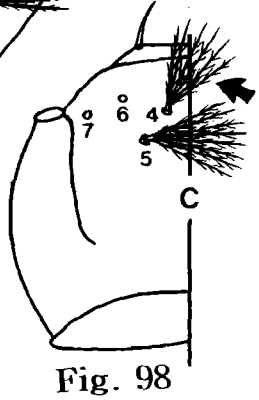

Fig. 98

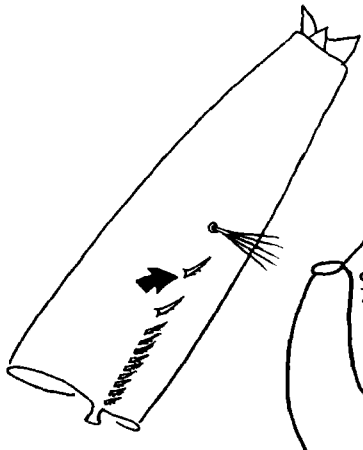

Fig. 99

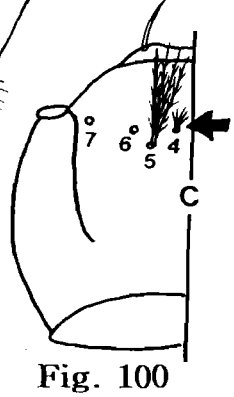

Fig. 100

7. Siphon with minute, 2-5 branched hairs near apex (Fig. 101) ..... *Ae. esoensis*

Siphon without minute hair near apex (Fig. 102) 8

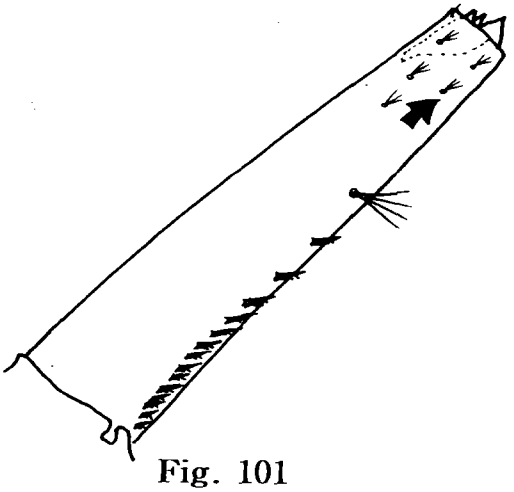

Fig. 101

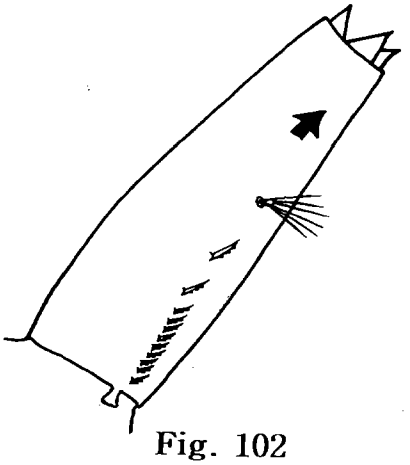

Fig. 102

8. Head hair 6-C single or bifid; 5, 6, 7-C not on a line (Fig. 103) 9

Head hair 6-C with 5 or more branches; 5, 6, 7-C on a line (Fig. 104) 10

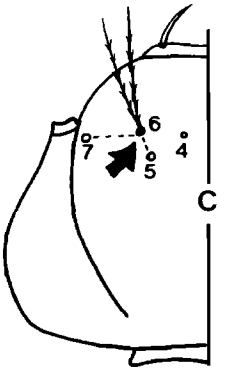

Fig. 103

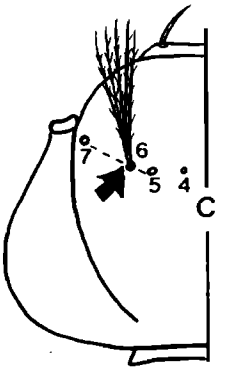

Fig. 104

9. Frontoclypeus of head with
granules (Fig. 105) ..... *vexans vexans*

Frontoclypeus of head without
granules (Fig. 106) ..... *vexans nipponii*

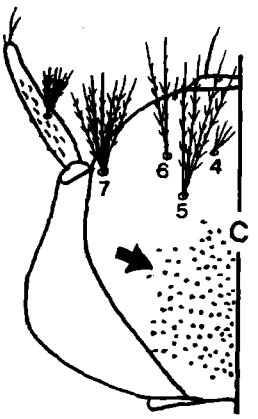

Fig. 105

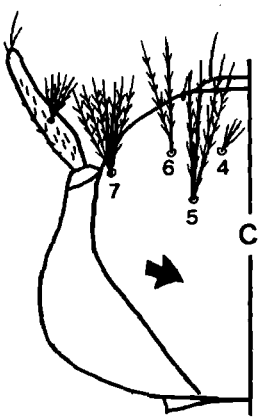

Fig. 106

10. Comb scales 16-20 (usually 20) in a patch,
individual scales rounded, evenly fringed laterally
and apically with spicules (Fig. 107) ..... *Ae. alboscutellatus*

Combscales 8-12 in an irregular row, individual
scales thorn shaped, with apparently 8-10 short, stiff,
subequal basolateral spicules on each side (Fig. 108) 11

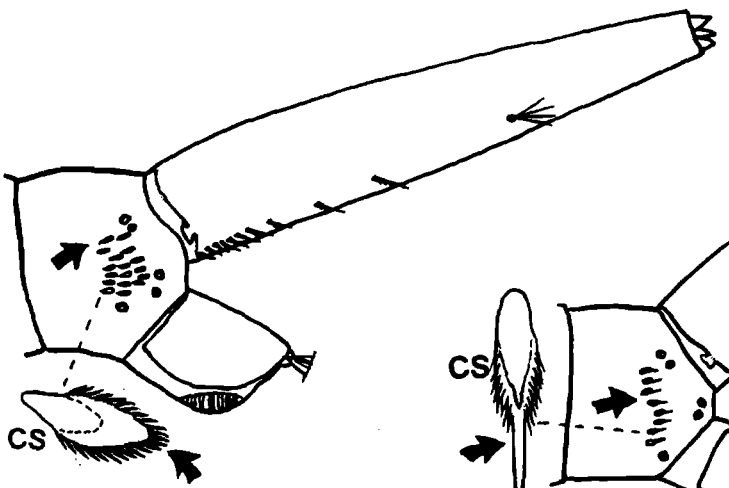

Fig. 107

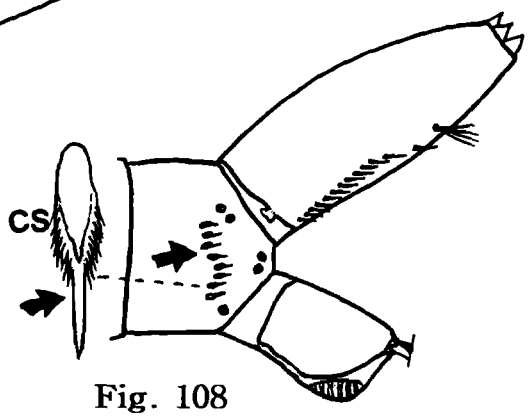

Fig. 108

11. Siphon stout at the middle; saddle narrowly incomplete; 1-X usually single, about 0.5 saddle length, inserted at posterior margin of the saddle (Fig. 109) ..... ***Ae. lineatopennis***

    Siphon not stout at the middle; saddle widely incomplete; 1-X very short, usually triple and inserted at subposterior margin of the saddle (Fig. 110) ..... ***Ae. bekkui***

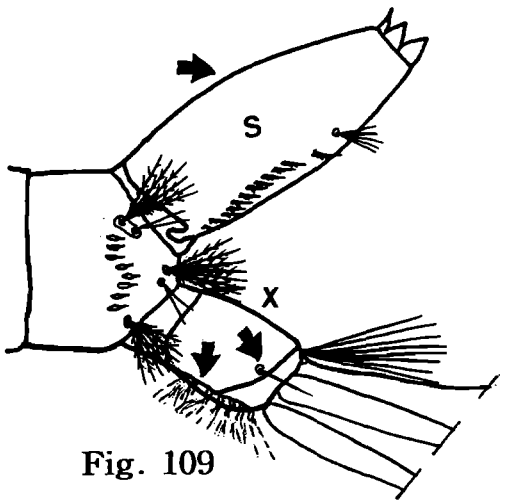

Fig. 109

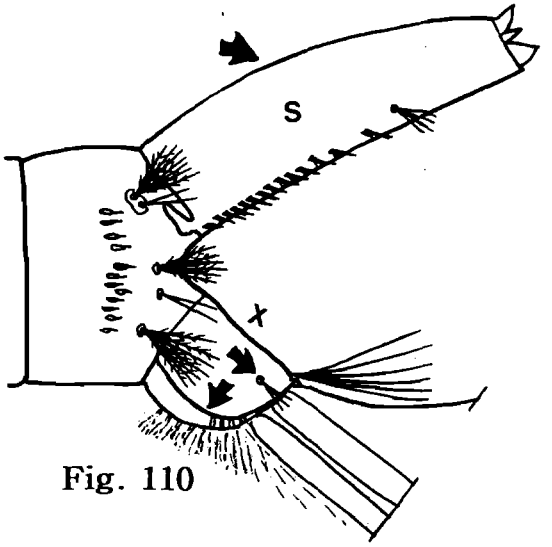

Fig. 110

12. Thoracic setae 1-M and 1-T very stout, on sclerotized basal callus (Fig. 111) ..... ***Ae. hatorii***

    Thoracic setae 1-M and 1-T weak, not on sclerotized basal callus (Fig. 112) 13

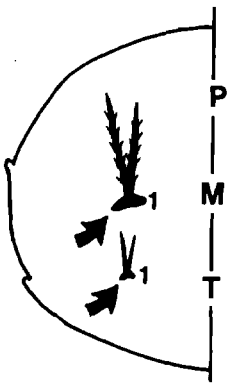

Fig. 111

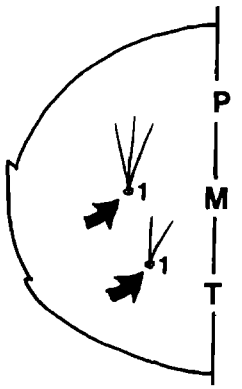

Fig. 112

13. Head hair 6-C very long, longer than head length (Fig. 113) ..... *Ae. alektorovi*

Head hair 6-C not longer than head length (Fig. 114) 14

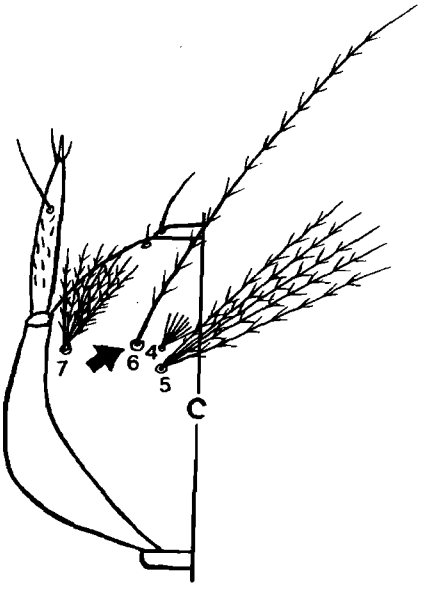

Fig. 113

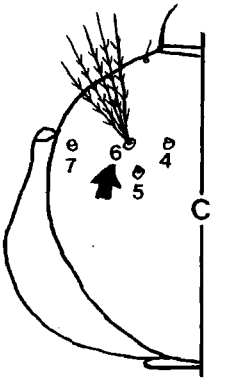

Fig. 114

14. Pecten teeth fringed on both side (Fig. 115) ..... *Ae. seoulensis*

Pecten teeth with basal spines on one side (Fig. 116) 15

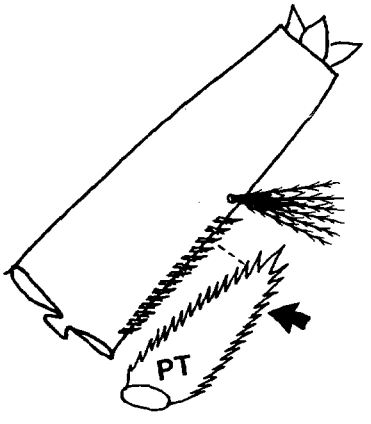

Fig. 115

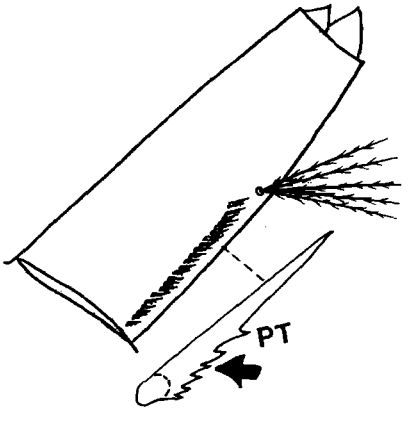

Fig. 116

15. Head hair 5-C single (Fig. 117) **16**

Head hair 5-C branched (Fig. 118) **17**

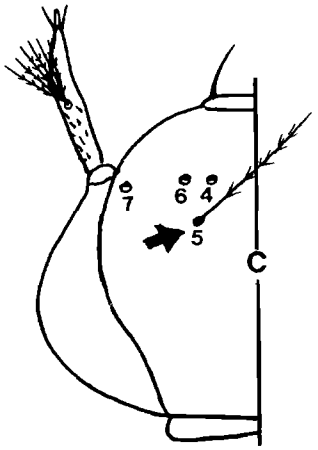

Fig. 117

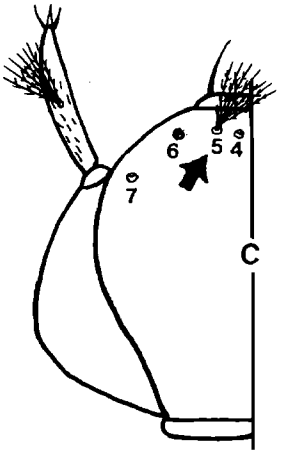

Fig. 118

16. Head hair 6-C branched; antennal hair 1-A single (Fig. 119) ..... ***Ae. oreophilus***

Head hair 6-C single; antennal hair 1-A branched (Fig. 120) ..... ***Ae. dorsalis***

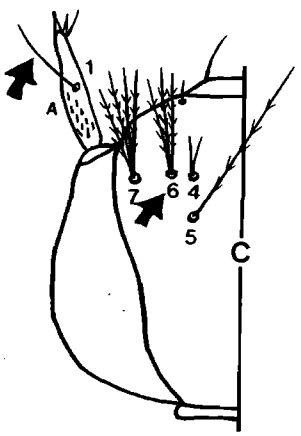

Fig. 119

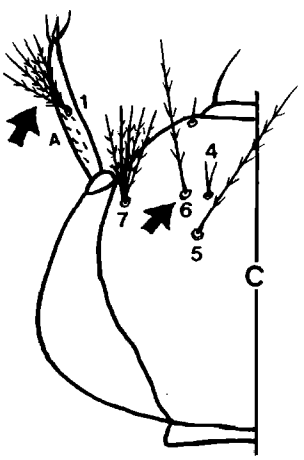

Fig. 120

17. Head hair 6-C with 2 branches; 4-C nearly as long as 5-C (Fig. 121) ..... ***Heizmannia lii***

Head hair 6-C with several branches; 4-C smaller than 5-C (Fig. 122) **18**

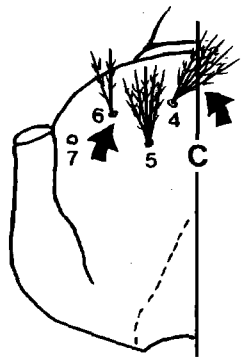

Fig. 121

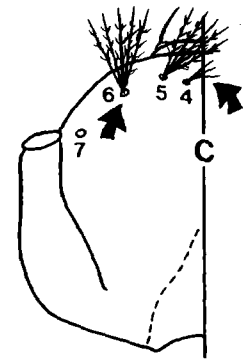

Fig. 122

18. Siphonal hair near apex; anal gills very short and round (Fig. 123) ..... ***Ae. togoi***

Siphonal hair toward middle of siphon; anal gills at least 3 times as long as wide (Fig. 124) **19**

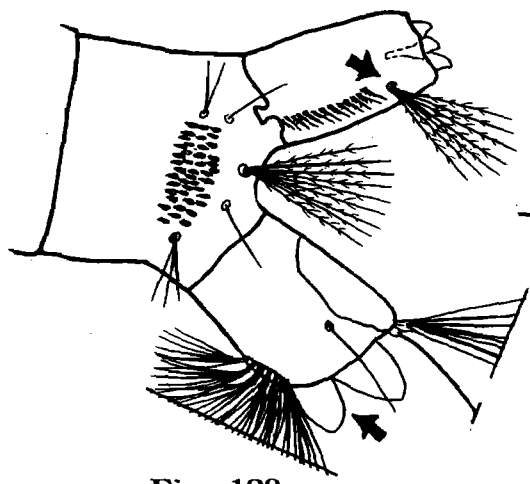

Fig. 123

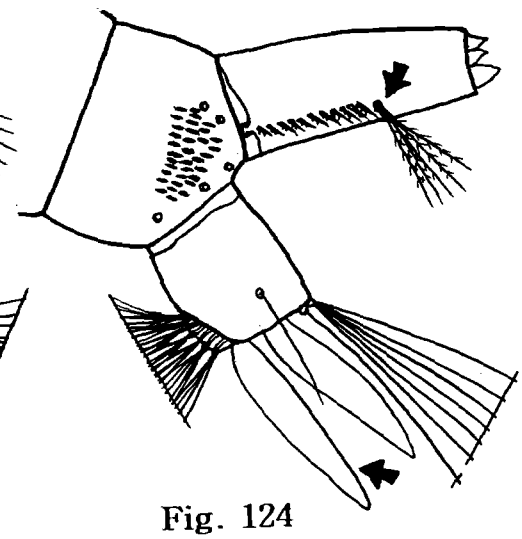

Fig. 124

19. Pecten with distal teeth widely spaced, extending beyond siphon hair to near apex (Fig. 125) ..... ***Ae. japonicus japonicus***

Pecten with all teeth more or less evenly spaced, not extending beyond siphon hair (Fig. 126) ..... ***Ae. koreicus***

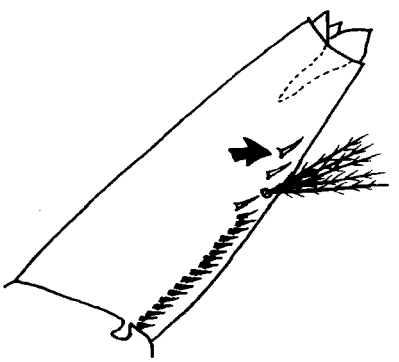

Fig. 125

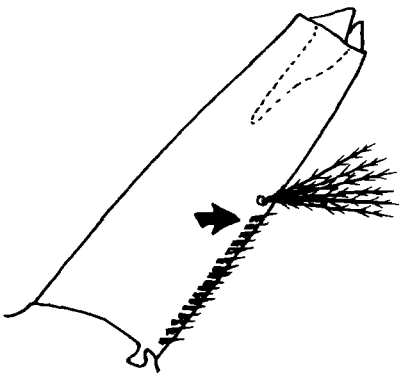

Fig. 126